[0035] FIGS. **2** to **4** each illustrate the case in which the coil connecting wire **5** between the connected location **20***a* and the connected location **20***b* includes a slack as a curved part in the circumferential direction and the radial direction when viewed from a rotation center, but the stress reduction effect can be obtained by the same principle in a case in which the coil connecting wire **5** includes a slack as a curved part in the axial direction as illustrated in FIG. **5**. However, the shapes illustrated in FIGS. **3** to **5** are examples of the modification, and the modification is not necessarily limited to these shapes.

[0036] As described above, according to the present embodiment, the coil connecting wire **5** can absorb a stress difference between the field winding **4** and the neutral ring **6** when a centrifugal force is applied, so that the field winding **4** does not pull the neutral ring **6**. In a specific configuration to achieve the absorption of the stress difference, the coil connecting wire **5** between the connected position **20***a* on the field winding **4** and the connected position **20***b* on the neutral ring **6** has a length longer than the length h of a straight line connecting the connected position **20***a* and the connected position **20***b*. More specifically, the coil connecting wire **5** includes a slack. In another specific configuration, the coil connecting wire **5** has flexibility. In still another specific configuration, these can be combined. Specifically, when having flexibility, for example, the coil connecting wire **5** may include a slack. These are merely exemplary, are not intended to exclude any configuration other than the specific configurations, in which the coil connecting wire **5** absorbs the stress difference between the field winding **4** and the neutral ring **6** when a centrifugal force is applied. Since the field winding **4** does not pull the neutral ring **6**, the stress applied on the neutral ring **6** can be reduced to provide an alternating-current excitation synchronous rotating electric machine having a longer lifetime.

[0037] In the present embodiment, unlike Patent Literature 1 and Patent Literature 2, the neutral ring is not embedded, which does not lead to an increase in worker-hour due to embedding of the neutral ring or the like. Providing an embedded member would result in a weight increase due to this member, and an increase in the rotor weight indirectly due to a need to provide a rotor coil support elongated in the axial direction like Patent Literature 2. The stress can be reduced without providing an embedded member, thereby preventing such a weight increase.

[0038] When embedded in the rotor coil support, the neutral ring contacts with the field winding, and thus a thermal stress increases as an increase in a temperature rise of the neutral ring, but the configuration described in the present embodiment eliminates the need for the embedding, thereby reducing the thermal stress increase.

[0039] The configuration described in the present embodiment employs such an idea from a viewpoint that the stress applied on the neutral ring is reduced by using deformation of the coil connecting wire instead of increasing the stiffness of a structure. Thus, in the present embodiment, since a redundant member to solidly support the neutral ring **6** is not used and the stress applied on the neutral ring **6** by a centrifugal force is reduced, the weight of the rotor **1** is not increased, and an efficiency improving effect due to reduction in current density and a thermal stress reduction effect due to heat generation suppression can be obtained. In addition, embedding of the neutral ring **6** does not need to be performed, and a thin line does not need to be provided (when a thin line such as a lead line is used, a lead holder for holding the lead line and a ring supporting member need to be provided, but in the configuration according to the present embodiment, a thin line such as a lead line is not used as the coil connecting wire. When large volume energization of the MW class is performed, a line having a large diameter is preferably used to reduce the current density and reduce any loss), thereby preventing an increase in worker-hour.

Embodiment 2

[0040] FIG. **6** illustrates a partially enlarged section view of the peripheral part of the rotor of an alternating-current excitation synchronous rotating electric machine according to an embodiment of the present invention (second embodiment). As an example of the present embodiment, unlike Embodiment 1, as illustrated in FIG. **6**, a cantilever is provided by joining an arc-shaped component including a conductor, with the neutral ring **6** at a connected location **20***c*, and the cantilever of the neutral ring **6** is joined with the coil connecting wire **5** at the connected location **20***b*. Any duplicate description of the above description will be omitted in the following.

[0041] In the present embodiment, in addition to the effect described in Embodiment 1, part of the amount of displacement of the field winding **4**, which cannot be absorbed through the expansion and contraction of the slack part of the coil connecting wire **5**, can be absorbed through deflection of the cantilever of the neutral ring **6**. When it is assumed that the field winding **4** is displaced in the forcible manner, a force P applied on the neutral ring **6** can be expressed by Expression (2) below from an expression for calculating the deflection amount of the cantilever.

$$P=3EIY/L^3 \tag{2}$$

In the expression, E represents the Young's modulus of the neutral ring **6**, I represents the second moment of area of the neutral ring **6**, Y represents the amount of forcible displacement of the field winding **4**, and L represents the length of the cantilever of the neutral ring **6**. When the connected location **20***c* is provided at a position separated from the connected location **20***b* as far as possible, a stress reduction effect in accordance with the cube of the distance L of the separation can be obtained. Thus, the cantilever of the neutral ring **6** is preferably as long as possible. However, this joining distance is limited by arrangement of other components in most cases. When m represents the number of coil connecting wires **5** in the alternating-current excitation synchronous rotating electric machine, and R represents the outside diameter of the neutral ring **6**, the length L of the cantilever of the neutral ring **6** is restricted by Expression (3) below.

$$L<2\pi R/m \tag{3}$$

Since a large stress reduction effect can be obtained only by modifying the shape of the neutral ring **6**, a modification based on the conventional alternating-current excitation synchronous rotating electric machine is possible. Specifically, the present embodiment may be applied to a configuration obtained by cutting the neutral ring **6** having a circular ring shape, adding a conductive arc component, and joining them. Although the present embodiment describes the case in which the neutral ring **6** is manufactured by joining a